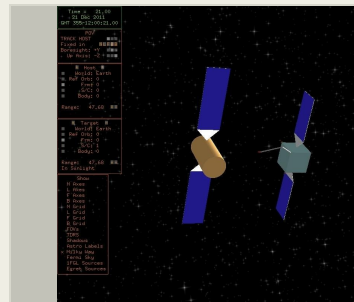## Project Introduction

The purpose of this IRAD is to integrate a small but full-featured attitude simulation application, 42 (a full-featured, simulation tool for analysis and visualization of spacecraft attitude and orbit dynamics), with CubeSat flight software to enable hardware-in-the-loop (HITL) testing.

The purpose of this IRAD is to integrate a compact but full-featured attitude simulation application, 42, with CubeSat flight software to enable hardware-in-the-loop (HITL) testing. We propose to investigate two possible implementations: running 42 on a GSE computer, as is traditional, or installing and running 42 on the flight processor itself. In either case, 42 will copy the GNC actuator commands, model the attitude and orbit dynamics and the space environment, and supply sensor measurement signals back to the GNC flight software, enabling closed-loop testing of the GNC flight software. Hardware interfaces may be switched on or overwritten individually or collectively, supporting software-in-the-loop, hardware-in-the-loop, and end-to-end phasing (polarity) testing. The benefit of running on the flight processor is that you completely sidestep complicated inter-processor and synchronization concerns; in this implementation, 42 would be removed or disabled before flight. This project will provide the capability to test flight software and hardware (including sensors, actuators, power systems, ect...) within a simulated on-orbit environment.

Anticipated Benefits

This could benefit several CubeSat missions that are currently planned (including CeREs, IceCube, LWADI and Dellingr) and potentially many more.

This project could potentially benefit any future CubeSat mission, internal or external. This capability could be provided as a service to industry or university small satellite projects and/or open the door for more partnership opportunities.

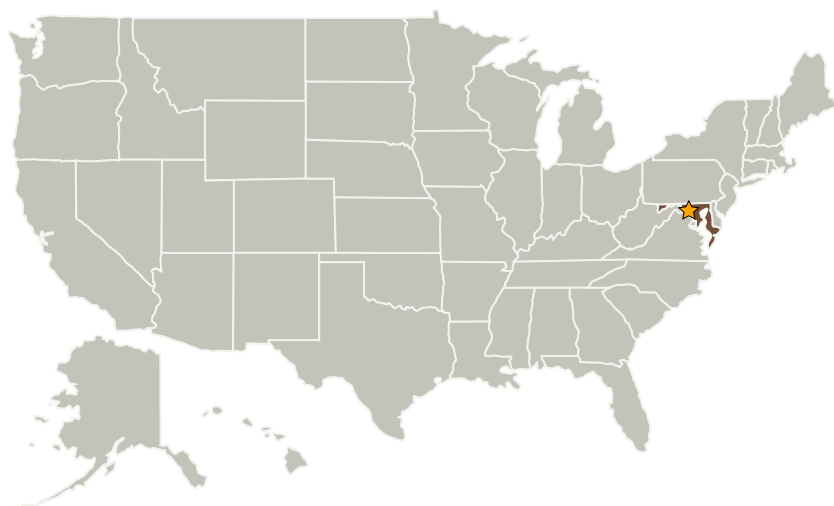42 Simulation Environment

Table of Contents

Primary U.S. Work Locations and Key Partners

Organizations Performing Work	Role	Type	Location
⭐Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations
Maryland

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Center Independent Research & Development: GSFC IRAD

Project Management

Program Manager:

Peter M Hughes

Project Managers:

Daniel A Mullinix
Dennis W Woodfork

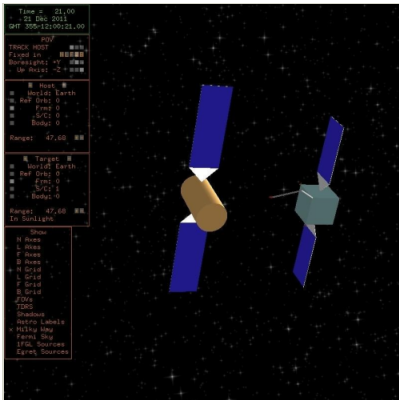**Principal Investigator:**

Cinnamon A Wright

Co-Investigators:

Damon C Bradley
Eric T Stoneking
Paul A Mason
Gary A Crum

Images

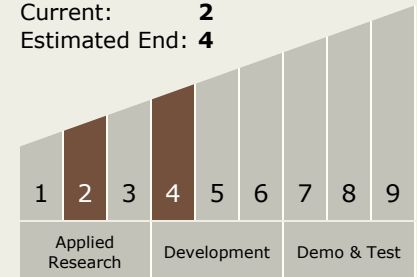**42 Simulation Environment**
42 Simulation Environment
(https://techport.nasa.gov/image/4191)

Links

NTR 1438286129
(no url provided)

Project Website:

http://aetd.gsfc.nasa.gov/

Technology Maturity (TRL)

Start: **2**
Current: **2**
Estimated End: **4**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

| Applied Research | Development | Demo & Test |

Technology Areas

Primary:

- TX11 Software, Modeling, Simulation, and Information Processing
  └ TX11.1 Software Development, Engineering, and Integrity
    └ TX11.1.3 Test and Evaluation